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Man-made organic compounds in the water supply to Sioux Falls, SD

Galen Hoogestraat
Hydrologist, U.S. Geological Survey

U.S. Department of the Interior
U.S. Geological Survey

Prepared in cooperation with the City of Sioux Falls

Key findings

- 76% of compounds analyzed were not detected
- No contaminant was detected above U.S. Environmental Protection Agency established Maximum Contaminant Levels (MCLs)
- Similar contaminants found in both groundwater and the Big Sioux River
- Herbicides are most prominent
- Less than half the compounds detected in source water were also found in finished water

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Focus of today's talk

- Study objectives
- Background on water supply
- Sample plan
- Preliminary results
- Summary

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Study objectives

- Characterize the occurrence of anthropogenic organic compounds in:
  - Source water
  - Finished water
- Identify probable sources of nitrate
  - (not presented in this talk)

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Background

- Sioux Falls ~155,000 population
- Primary water source: alluvial aquifers and Big Sioux River
- Concerns about nitrate concentrations in Big Sioux River
- Desire to be pro-active about monitoring anthropogenic organic compounds

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Minnesota

Watertown

Brookings

Madison

Big Sioux River

Brandon

Sioux Falls

South Dakota

Nebraska

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South Dakota

Sioux Falls

Explanation

Big Sioux Drainage Basin

Groundwater sources

Colton
Baltic
Crooks
Hartford
Brandon
Sioux Falls
29
90
229
River intake

Aquifers used by the city of Sioux Falls

(modified from Martin and others, 2004)

- Big Sioux Aquifer
- Skunk Creek Aquifer
- Splitrock Creek Aquifer
- City well

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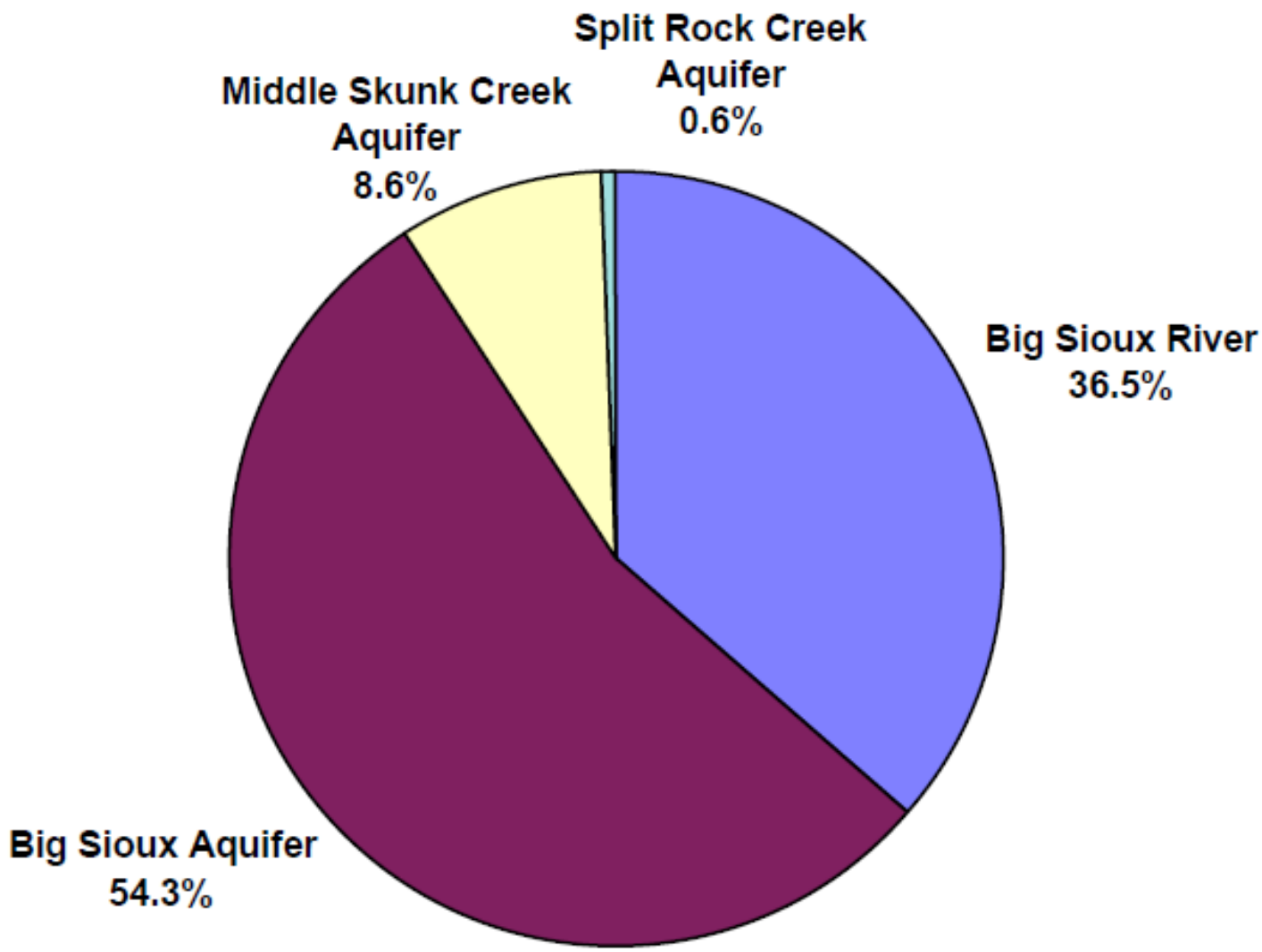
Sioux Falls Water Purification Water Production, 2008



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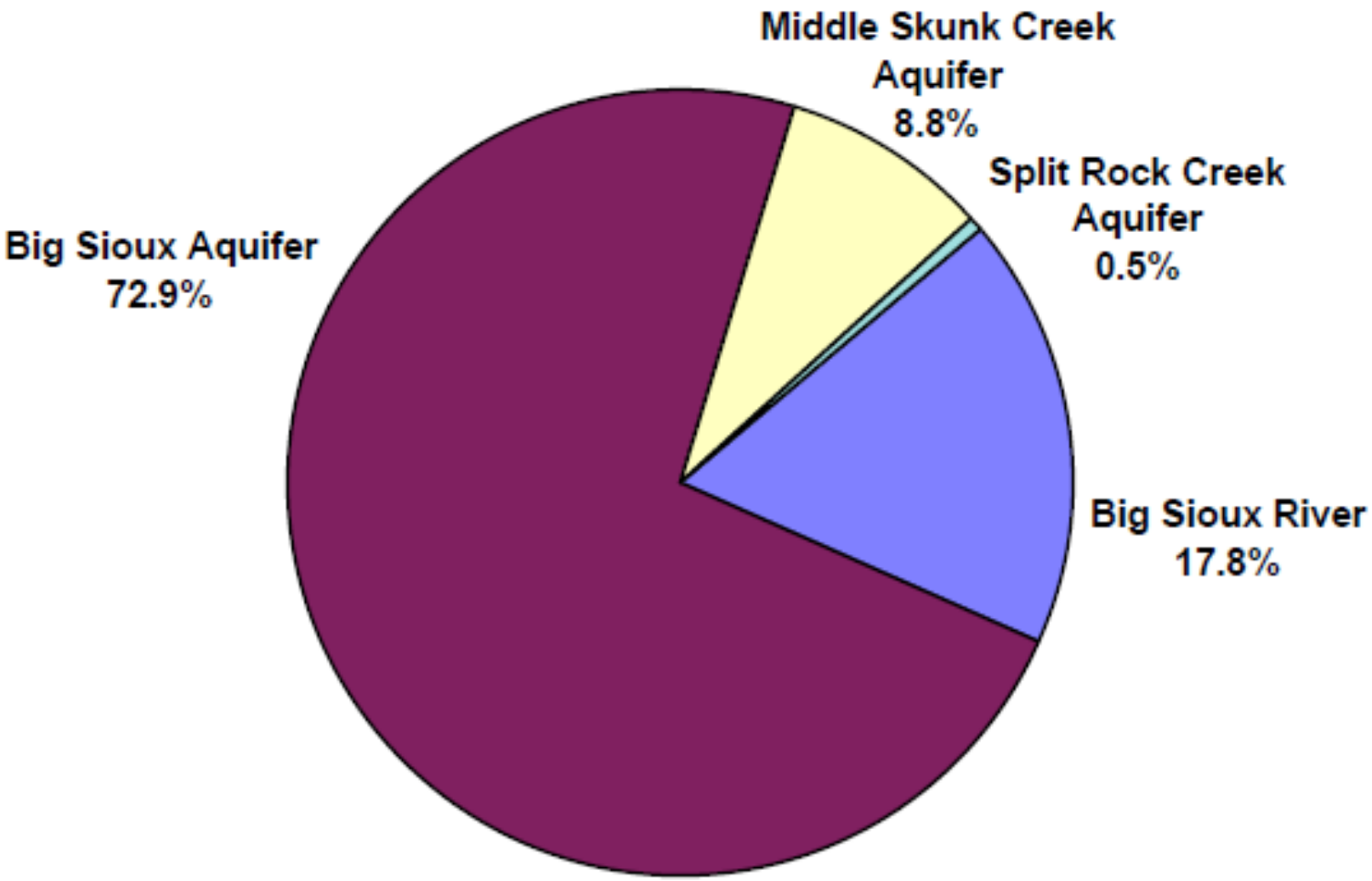
Sioux Falls Water Purification Water Production, 2009



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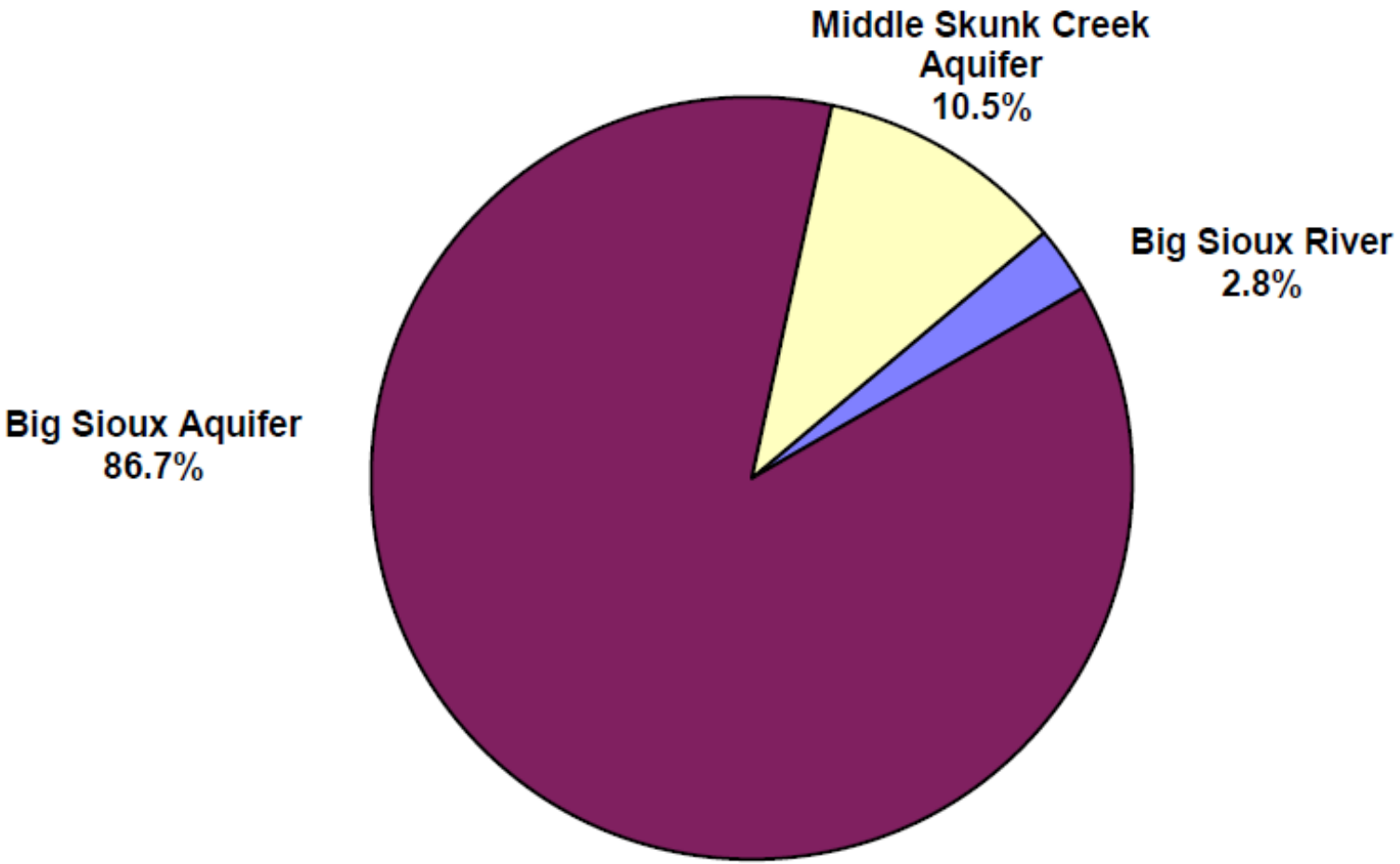
Sioux Falls Water Purification
Water Production, 2010



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Sampling plan

- Paired samples at intake stations and finished water tap
- 11 sampling visits over 18 months
- Constituents:
  - Pesticides
  - Pharmaceuticals – Hormones – Antibiotics
  - Household / industrial products
  - Nitrate (nitrogen and oxygen isotopes)

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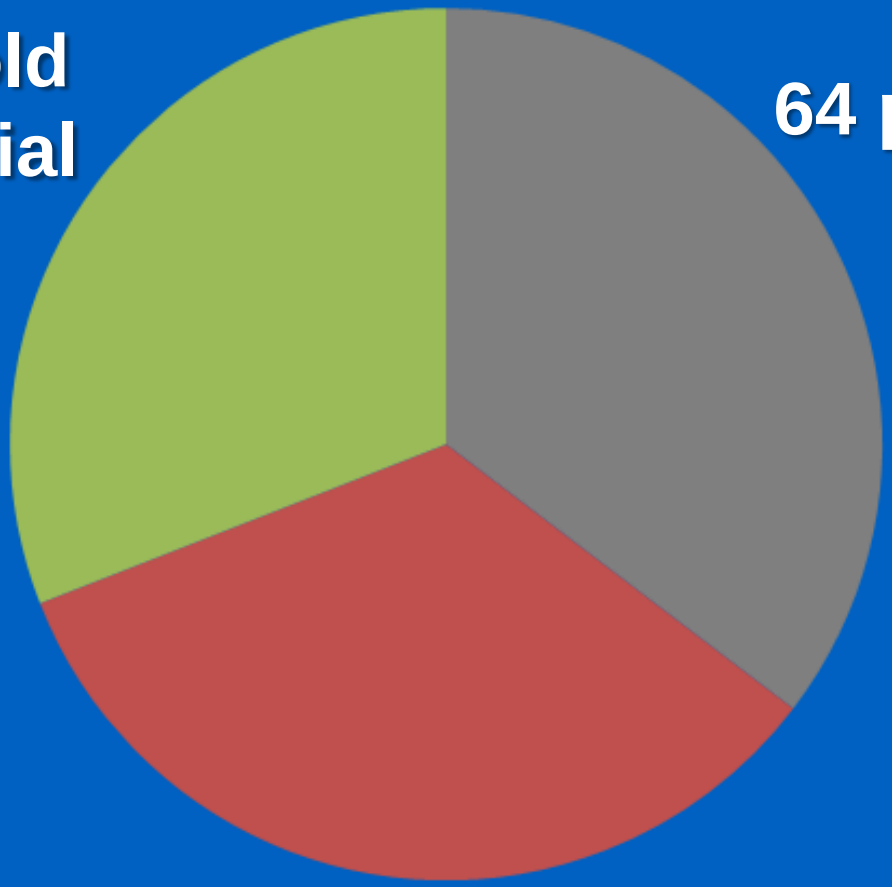
Use-group breakdown

59 household and industrial products



64 pesticides

61 pharmaceuticals, antibiotics, hormones

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Regulated vs. unregulated

- 8 regulated contaminants
  - Examples:
    - Atrazine (herbicide)
    - TCE (solvent)
    - Bromoform (disinfection byproduct)

- 176 unregulated compounds
  - How to put results in context?
    - USGS “Health-Based Screening Levels” (HBSL)
  - Examples:
    - Caffeine (stimulant)
    - Cotinine (nicotine)
    - Bisphenol-A (plasticizer)
    - Prometon (herbicide)

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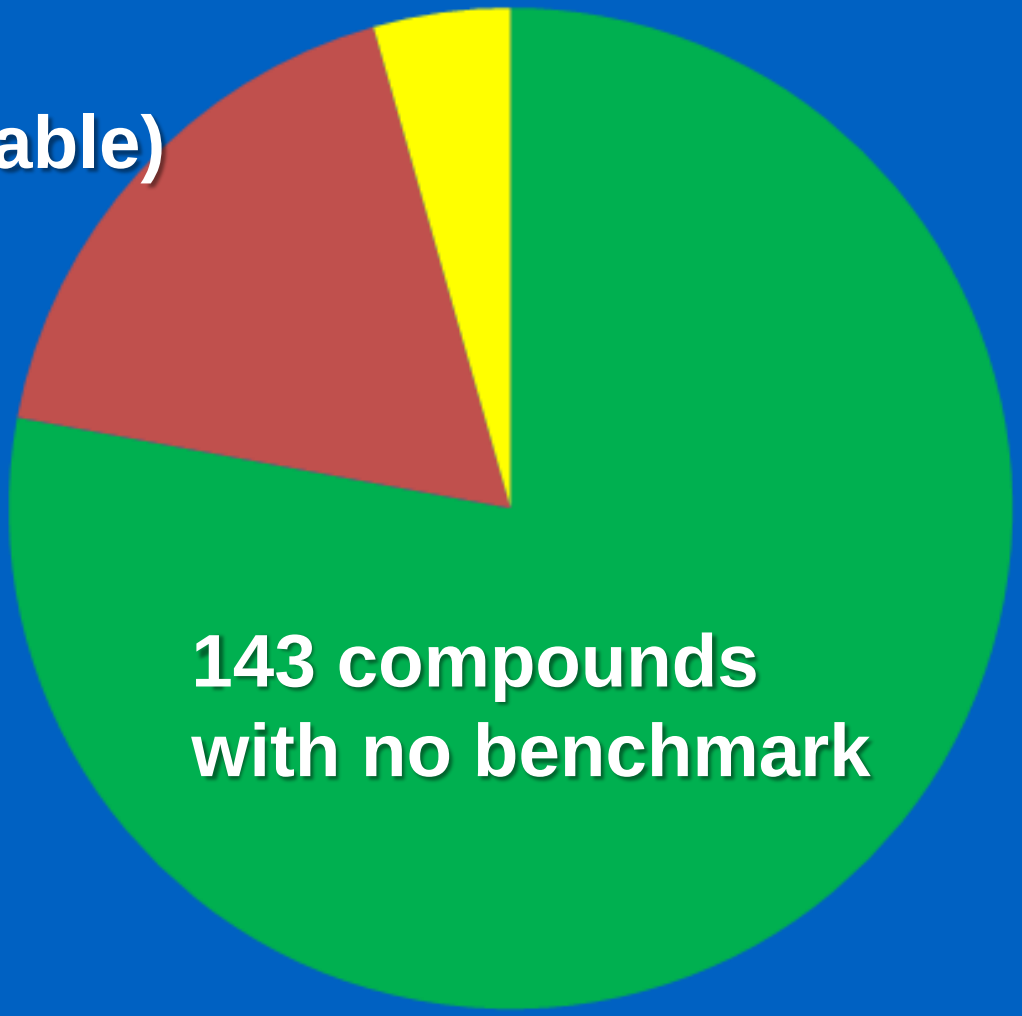
Benchmark comparison



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Preliminary results at Sioux Falls

Organic compounds

- **Very few compounds detected (44 out of 184)**
  - **About 76% of 184 total compounds were NOT detected in any sample of source or finished water**
- **Some compounds frequently detected**
  - **Atrazine, prometon, sulfamethoxazole, carbamazapine (all sites)**
  - **Caffeine, cholesterol, estrone (Big Sioux River only)**
  - **5-Methyl-1h-benzotriazole, p-cresol (groundwater only)**
  - **Bromoform (finished water only)**
- **Low concentrations**
  - **No concentration greater than MCL or HBSL**
  - **92% of concentrations less than 1 part per billion (ppb)**

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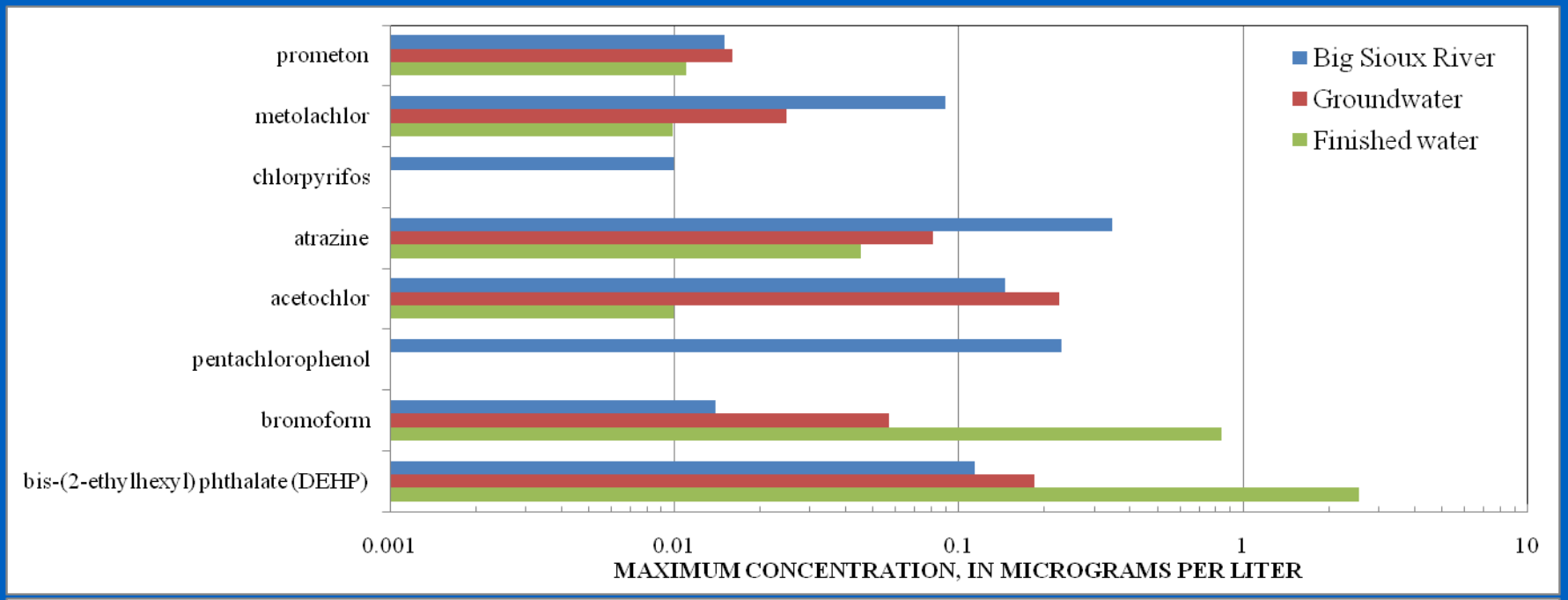
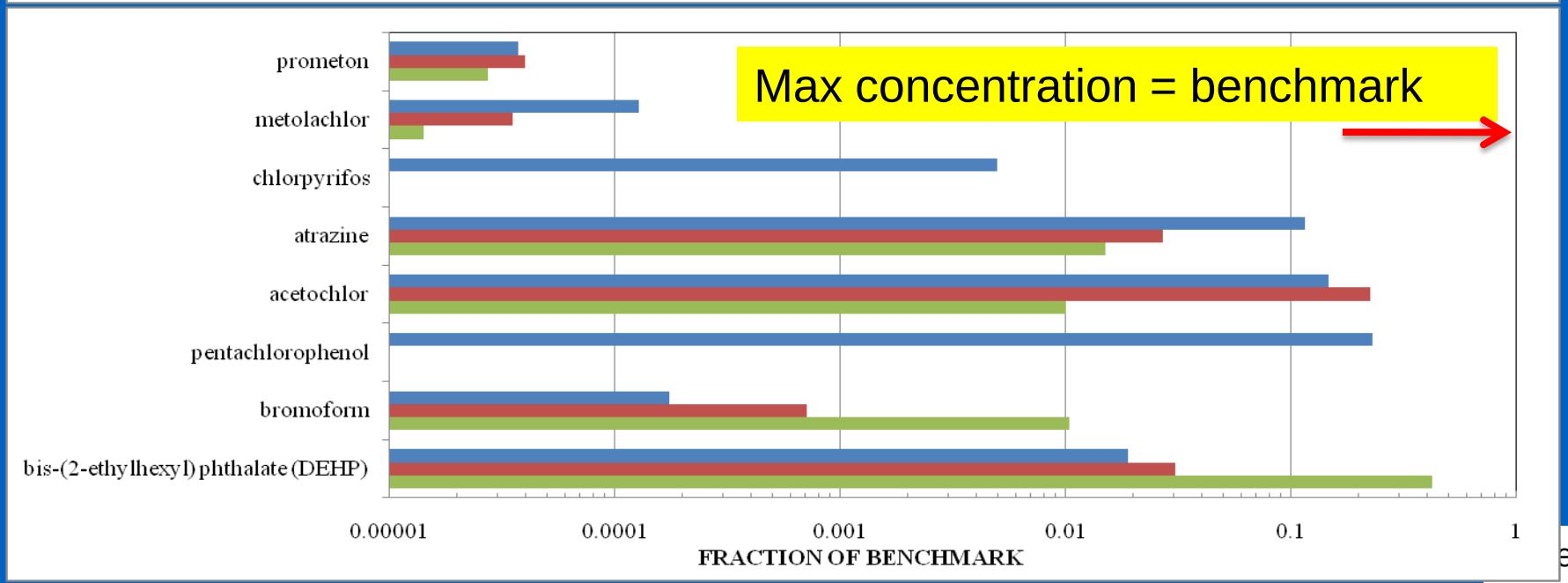
Relation to benchmarks

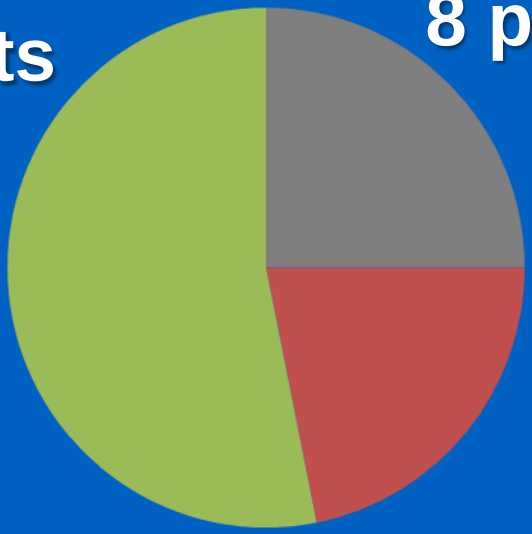




Compounds detected in source water

17 household and industrial products

8 pesticides



7 pharmaceuticals, antibiotics, hormones

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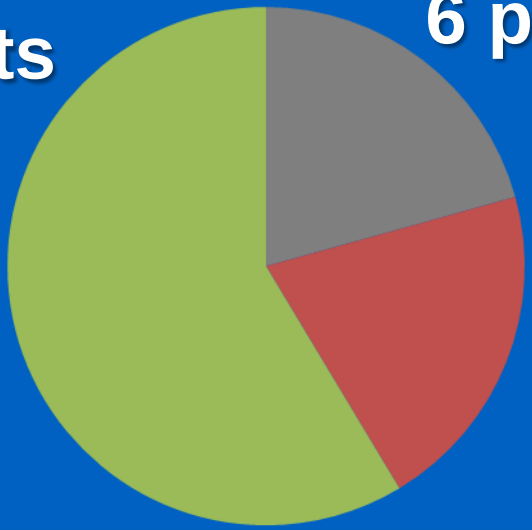
Compounds detected in source water

17 household and industrial products

6 pesticides



6 pharmaceuticals, antibiotics, hormones

Groundwater

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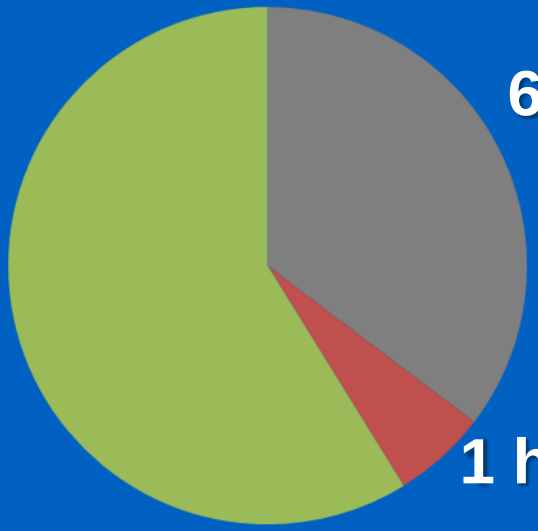
Finished water detections

- Plasticizers/solvents, disinfection byproducts, herbicides
  - Prometon (herbicide)
    - Max concentration = 0.01 parts per billion
    - HBSL = 400 parts per billion (40,000 x higher)
- No pharmaceuticals or antibiotics were detected

10 household and industrial products



6 pesticides

1 hormone

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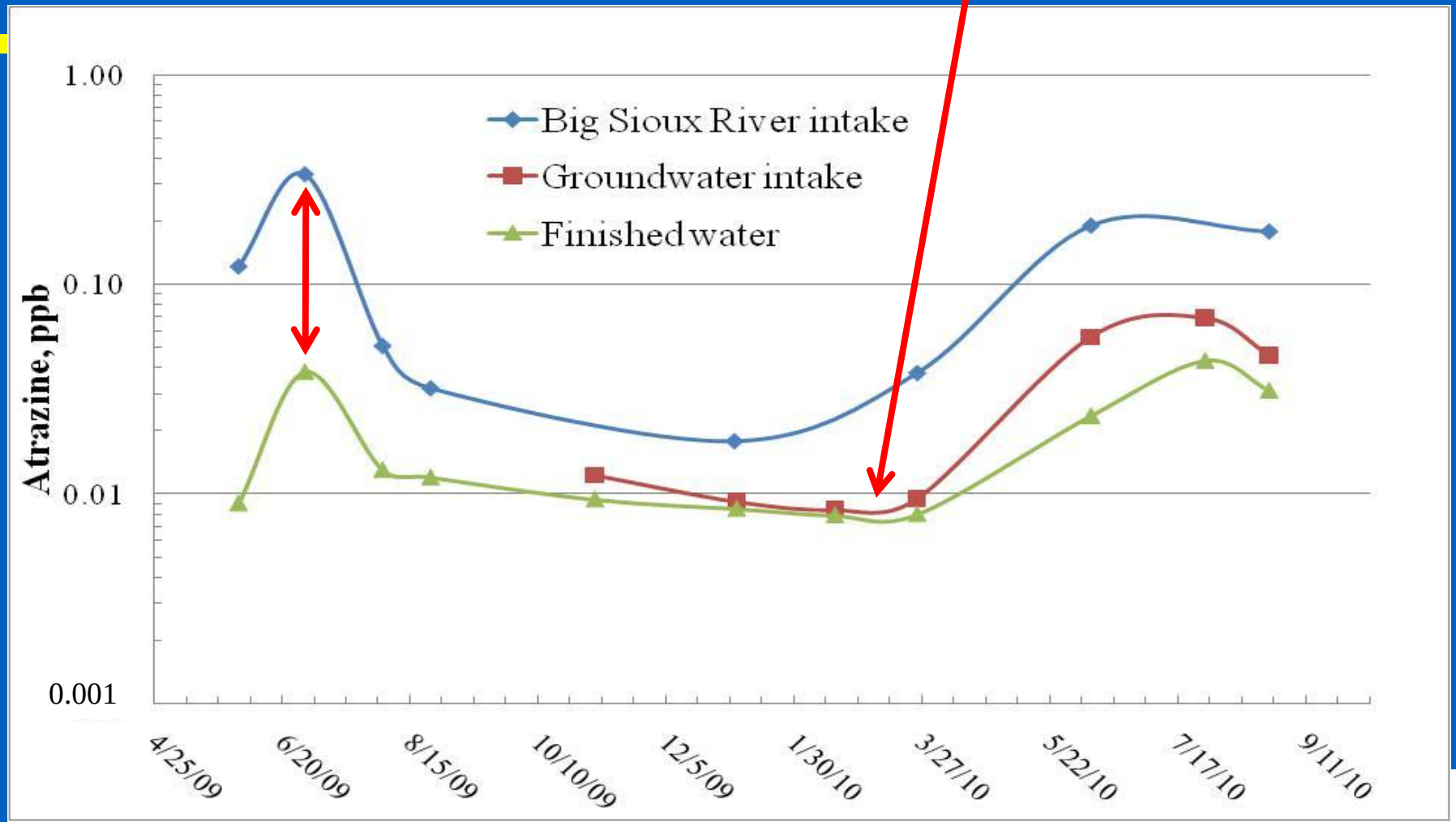
Atrazine

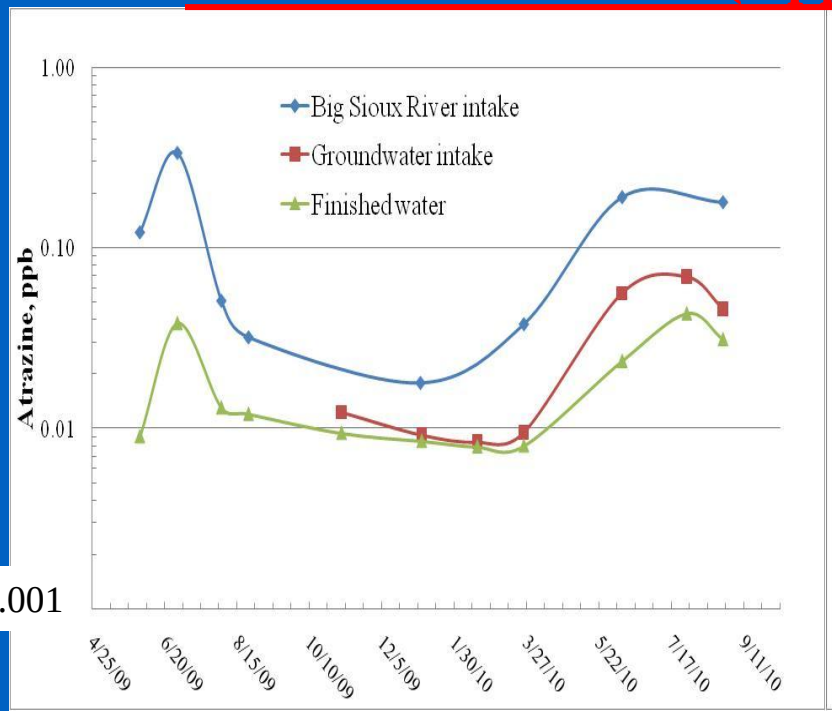
- Finished water concentration is an order of magnitude less than Big Sioux River (dilution with groundwater)
- Groundwater concentration is similar to finished water

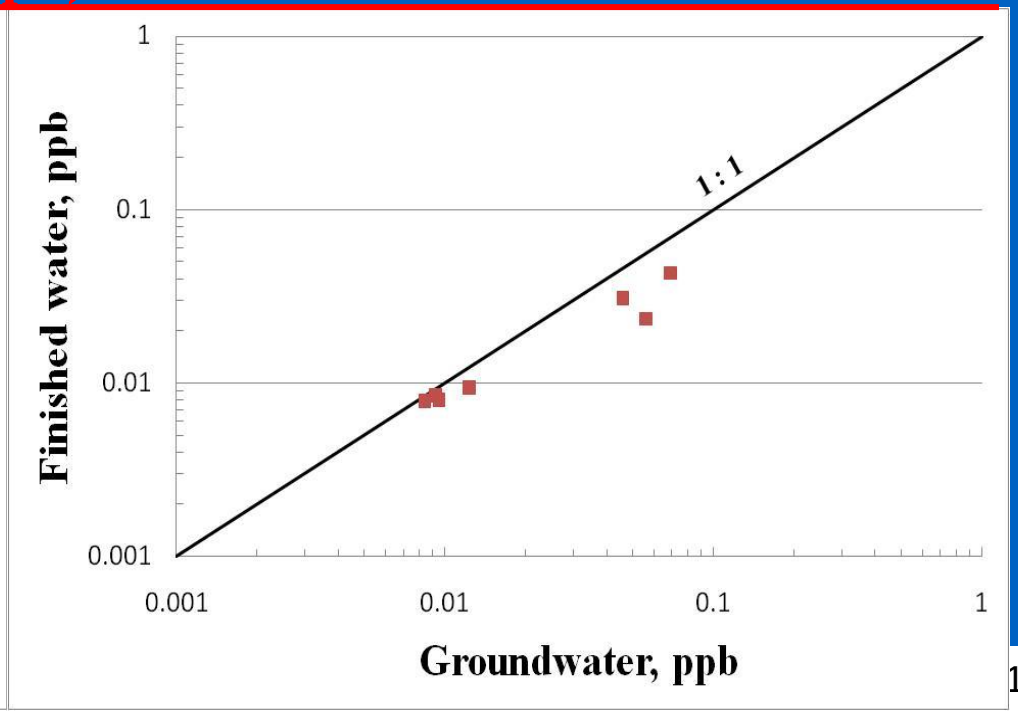


Atrazine

- Finished water concentration is an order of magnitude less than Big Sioux River (dilution with groundwater)
- Groundwater concentration is similar to finished water
- NOTE: Drinking-water MCL = 3 ppb
  - 10 x greater than largest measured concentration in BSR in 2009-10
  - 100 x greater than largest finished water concentration 2009-10

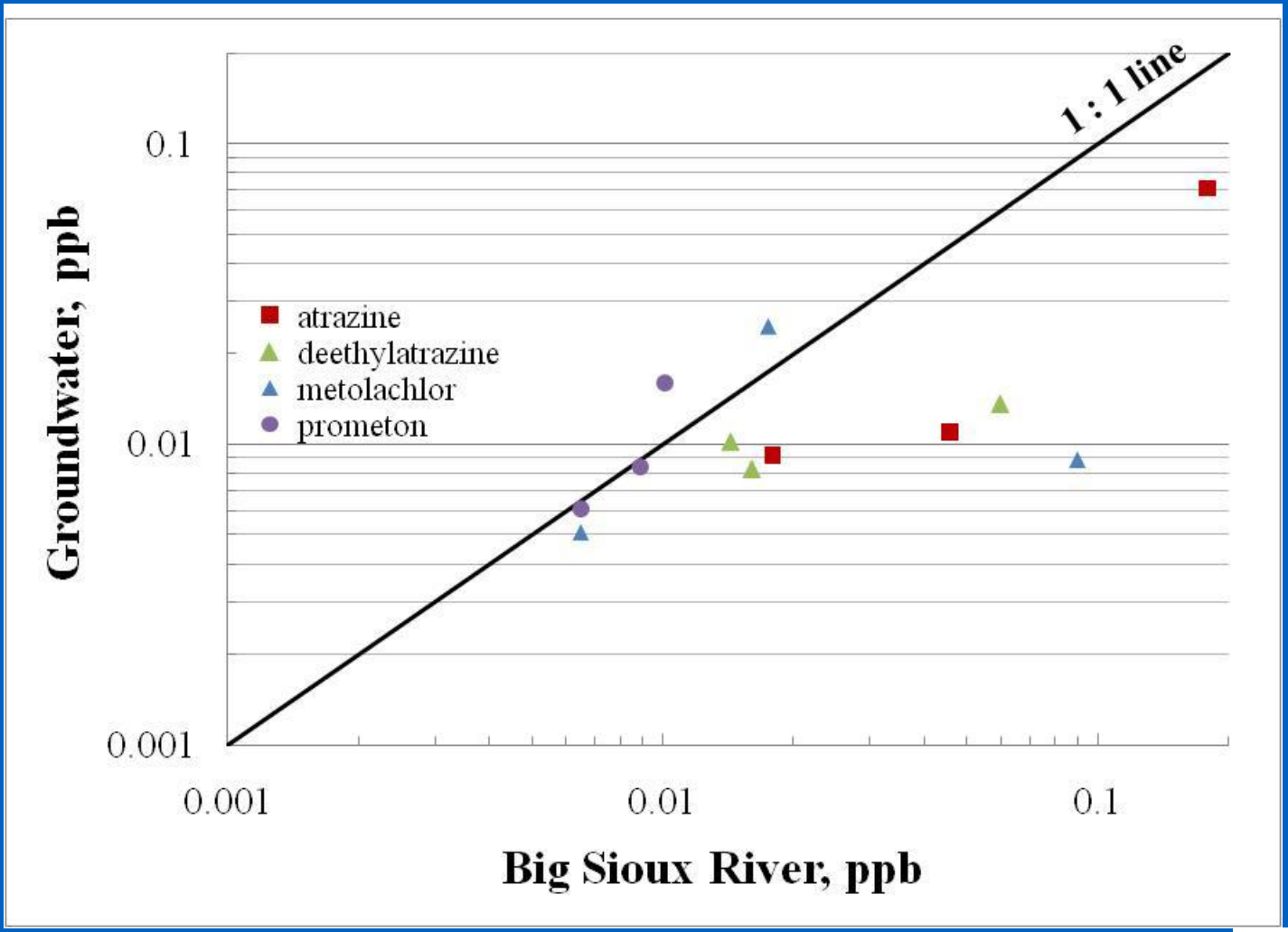
✓ MCL (3 ppb) ↘





Groundwater vs. Big Sioux River

- Metolachlor and prometon concentrations are similar in BSR and groundwater



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Summary

- 76% of compounds analyzed were not detected
- No contaminant was detected at concentrations near MCLs or HBSLs
- Similar compounds detected in both groundwater and the Big Sioux River
- Of the compounds analyzed, herbicides are most prominent
  - Predominantly agricultural sources
- Less than half the contaminants detected in source water were in finished water

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Questions?
ghoogest@usgs.gov
(605) 394-3264